

Radio Astronomy

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This article reports on the activities of the Deep Space Network in support of Radio Astronomy operations during the first quarter of 1981. Preliminary results of the use of a low-noise maser on loan from NRAO are presented, as well as updates in DSN support of experiments sanctioned by the Radio Astronomy Experiment Selection Panel.

I. Introduction

Deep Space Network (DSN) 26-, 34-, and 64-meter-antenna stations are utilized in support of three categories: NASA Office of Space Science (OSS), Radio Astronomy Experiment Selection (RAES), and Host Country.

II. Radio Astronomy Operations

A. NASA OSS Category

During this period, support was given for 95 hours of station time for Planetary Radio Astronomy (OSS 196-41-73) and Interstellar Microwave Spectroscopy (OSS 188-41-55-12-55) at DSS 43 utilizing the Tidbinbilla Interferometer (OSS 188-41-55-16). This support includes the installation of a K-band (20-25 GHz) maser on loan from the National Radio Astronomy Observatory (NRAO). A particular observational objective of this configuration is the search for spectroscopic lines of molecules. Of special interest is the search for interstellar molecular water at 22.235 GHz.

Preliminary results of work in progress reveal startling technological as well as scientific advances. A reflection-type maser is used as the first RF amplifier, providing an instantaneous bandwidth of about 150 MHz. A feature of this system, which is unique to low noise systems is the beam switching allowed by a cryogenic switch in front of the maser. Two avenues of spectral analysis are available: a 256-channel digital FFT (Fast Fourier Transform) spectrometer (10-MHz bandwidth) and a wideband 36-channel filter bank system. To date, this configuration has measured a system temperature of about 65 K at zenith and aperture efficiency of about 20% at 45° elevation. Observationally, three new water-line masers, as well as six ammonia-line sources, have been detected thus far.

B. RAES Category

1. RA 175 (SS433). During the first quarter of 1981, the Goldstone 26-meter station supported VLBI observations of the source SS433 (1909 + 04) for a total of 55.5 hours. These observations represent continuing efforts in support of the experimental objective of resolving this bizarre galactic object

to determine its angular radio structure and possibly its origin. Preliminary results are reported in *TDA Progress Report 42-62, January - February 1981*.

2. RA 176 (Twin Quasi-Stellar Object (QSO) VLBI). 51.5 hours of 64-meter antenna time (DSS 14 and DSS 63) was devoted to observing two apparent twin QSOs: 0957 + 561 A, B and 1038 + 528 A, B. The first twin is postulated to be a single QSO, whose image has been optically split by an intervening galaxy, the mass of which is thought to be acting as a gravitational lens. This is supported by the identical red shifts and other structural similarities between the A and B components of 0957 + 561, as well as independent optical resolution of the intervening galaxy. 1038 + 528 A, B is considered to be a coincidental twin or double QSO, analogous to optical or apparent binary stars. Of approximately 1500 known QSOs, these two sources are unique as the only known apparent twins. Proof of the gravitational lens effect has ramifications in terms of determining mass distribution in the cluster of galaxies of which the lens is a member as well as the location and distance to the QSO. The double QSO displays apparent morphological changes with time, the explanation of which could be useful in resolving questions concerning structure, origin, and evolution of QSOs in general.

The DSN's participation in this experiment was as an integral component of a VLBI network encompassing radio observatories across the North American and European Continents.

3. RA 177 (Milliarcsecond VLBI). In the ongoing statistical investigation into milliarcsecond quasar and galactic nuclei to determine the frequency of their occurrence, the DSN supported 34 hours and 50 minutes of observations with 64-meter antennas (DSS 14 and DSS 63) utilizing VLBI techniques.

C. Host Country

Pulsar observations conducted for the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Australia, as described in *TDA Progress Report 42-60, September-October 1980*, are the only Host Country activities to report for this period. This continuing research is supported by the 26-meter antenna at Honeysuckle Creek (DSS 44) for six hours per week, allocated as two distinct periods of three hours each.